April 25, 1989

MEMO TO: Mark Levin
CSD
Rockwell International
Rocky Flats Plant
Box 464
Golden, CO 80402

FROM: Michael Richard, Ph.D.
1025 B Davidson Drive
Fort Collins, CO 80526

RE: Summary of Discussion on Toxicity Detection and Control in the Waste Treatment System at Rocky Flats.

Following is a brief summary and discussion of possible toxicity detection and control measures for the waste treatment system at Rocky Flats resulting from our meeting on 4/18/89.

The basic problem is the unplanned and intermittent release of chemicals to the waste treatment system that are toxic. These materials may be comprised of a multitude of possible chemicals, ranging from metals to solvents to fuels to organic chemicals (and radioactive materials). A listing of all possible toxic materials that potentially could be released to the waste treatment system would be lengthy.

The need is to be able to detect these materials in the waste stream and to initiate corrective action to prevent damage to the sewage treatment plant (STP) or their release off-site on a real time and truly effective basis.

Possible Approaches

1. Detection of Specific Toxicants.

This approach would involve a priori knowledge of possible major toxicants that could occur and the availability of specific detectors for each toxicant. Unfortunately, the availability of such detectors is extremely limited. These certainly can be developed, but the cost would be high. Further, these would require frequent and regular maintenance and calibration. Several existing detectors would include spectrometric flow-through cells for ultraviolet-absorbing or fluorogenic compounds and gas vapor detectors, now widely used in detecting leaking underground storage tanks. Specific ion probes exist, mostly for inorganics, that could be used.

2. Use of Surrogate Parameters.

This approach uses one or several aggregate properties to measure the possible presence of toxicants -- generally pH and conductivity. These detection criteria may not detect many possible toxicants, e.g. organic solvents or fuels.

3. Use of an Intergrating Toxicity Measure.

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This approach uses detection of toxicity to the STP activated sludge

microorganisms or other biological indicator to assess the occurrence and severity of toxicants. This method simply establishes the presence of toxicants at levels of environmental damage, but does not give the identity of the toxicant(s). Two specific methods widely used are:

1. Use of oxygen uptake rate (OUR) of the activated sludge as an indicator of toxicity. This is done by performing manually the OUR test at the STP on a regular and frequent basis. One variation is the use of an automated, on-line respirometer at the STP (e.g. Arthur Technologies). An alternative, somewhat more sophisticated, is the use of the Microtox assay system.

2. Use of frequent microscopic examinations of the activated sludge at the STP and recognition of the signs of toxicity.

Use of any of the above approaches would also require an action plan to divert the wastes to a holding basin, to analyze the wastes fully and rapidly to determine what toxicants are present, and a specific treatment plan in place to render the waste safe to discharge to the system. Options might include pH neutralization, metals precipitation by alum or other coagulant, or powdered activated carbon treatment if organics are involved. Virtually each major toxicant that could potentially be released to the waste treatment system would require a detailed response plan in place.

Alternative Approach to Toxicity Control

An alternative approach to toxicity control would be to install and operate a tertiery treatment process downstream of the STP that would remove all toxicants before off-site discharge. The advantage of this approach (the shot gun approach) is its failsafeness and reliability. The two best such tertiery treatment processes would be reverse osmosis (RO), a physical-chemical process, and a constructed wetlands, a biological process. A brief description of a constructed wetlands follows:

> This is an artificially constructed wetlands ecosystem that incorporates by design a variety of treatment conditions including microbiological biodegradation of toxicants, physical straining of materials, and chemical precipitation, adsorption and complexing of toxicants. All possible microhabitats are included by design (e.g. aerobic and anaerobic treatment conditions) to provide a maximum variety of pollutant removal mechanisms. This can be lined to prevent groundwater contamination and can be enclosed in a greenhouse to avoid cold weather operation problems, to prevent contact with wildlife, and to incorporate capture of solar energy in the treatment process.

Advantages of the RO process are its proven effectiveness in removing most toxic materials, although several classes of materials can pass through this system, e.g. solvents. Disadvantages of the RO process are its high initial cost; its high operation and maintenance costs; the problem of disposal of the brine waste possibly containing toxic materials; and the fact that it is not 100% reliable -- there will be some down time.

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Advantages of the constructed wetlands approach are that it is relatively inexpensive to construct and operate; it has low operation and maintenance costs (no moving parts); it is effective for probably all toxicants; and it can utilize solar energy for treatment. Disadvantages are that it could possibly be severely impacted by a large toxicant release (as all biological systems); it requires careful design to achieve all objectives; it is not an "off-the-shelf" technology; and it requires periodic "cropping" and disposal c the removed material.

Rec mmendations

Short-Term

Install a sensor or detection station in the waste treatment system directly upstream of the existing diversion valve and holding tanks. Exceedance of set parameters would trigger diversion of wastes to the holding basins and set off an alarm requiring immediate investigation. The specific detection devices to employ are a dilemma. Currently, only pH, conductivity, and a specific hydrocarbon vapor detector are suggested as measurement devices. Further research into existing detection devices is required.

Long-Term

No one single plan would suffice to achieve the goals of protection of the STP and prevention of off-site movement of toxicants. What is needed is a two tiered approach. First, a system needs to be set up at the STP to detect waste biotoxicity and a response plan prepared to divert wastes to a holding basin until wastes prove no longer toxic. Second, a tertiery waste treatment process is to be installed downstream of the STP that would insure no off-site release of toxicants.

Specific Recommendations

1. Establishment of a biotoxicity measurement capability at the STP, to be operated daily by the STP operator or other personnel. This could be either (a) daily or twice daily measurement of the activated sludge OUR by manual methods; (b) purchase and installation of an automatic, on-line respirometer; or (c) use of the Microtox bioassay manually. Microscopic examination (using phase contrast) of the activated sludge should be performed in conjunction with the above biotoxicity test(s) for evaluation of actual impacts on the STP.

2. Perform an in-depth evaluation of the RO and constructed wetlands tertiery processes to further treat the STP effluent so as to ensure no off-site movement of toxic materials.

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April 21, 1989

MEMO TO: Mr. Bill Elliot
Bldg. 124
Rockwell International
Rocky Flats Plant
P.O. Box 464
Golden, CO 80402

FROM: Michael Richard, Ph.D.
1025 B Davidson Drive
Fort Collins, CO 80526

Dear Bill:

Enclosed please find a progress report for work to date at the STP on contract number ASC 40600WS. This report departs from the original plan of a bimonthly reporting and represents a midway (three month) report. I made this change so as to completely document the impacts of the unexpected chromium release 2/23/89 and the subsequent recovery of the activated sludge system. The enclosed invoice reflects the additional time frame of the report. Please call me at 491-7909 if you have any questions concerning the report, or the study in general. I will be coming down to visit the STP the end of next week or the first of the following week. We can meet to discuss the report at that time, if desired.

Sincerely,

Michael Richard, Ph.D.

cc. C. Sundblad, Bldg. 250

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Rockwell International

Rockwell International
AERO
Rocky Flats Plant
P.O. Box 464
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Number of pages
(excluding cover sheet): _____

FAX COVER SHEET

Date: 4/2/89

To: Cindy Sundblad
Env. Mgm't.

ToTelephone No: _____

From:
Mark Levin

From Telephone No: 4237

To FAX Number: 7198

From FAX Number: 320- (FTS)
(303) 966-2126 Commercial

Rockwell Verification Number: _____

Operator: _____

Remarks: _____

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APR 07 '89 13:11 TELECOM INSTALLATION 966-2126